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# *Breast cancer on social media: a quali-quantitative analysis of the content that generates more public engagement and how to improve its reliability*

**Ph.D. thesis booklet**

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## INTRODUCTION

Cancer is a group of over 100 diseases that can start in almost any organ or tissue of the body when cells grow uncontrollably, go beyond their usual boundaries (in a process called metastasis) and spread to other organs (World Health Organization, 2018). Tumors or neoplasms are classified as malignant or benign; the former are called cancer, the latter are not (Patel, 2020). There are two main categories of cancers: hematologic cancers, which affects blood cells, such as lymphoma, multiple myeloma and leukemia, and solid tumor cancers, which affects any other part of the body; most frequent types are breast, lung, prostate and colorectal cancers (American Cancer Society, 2020b).

### Cancer epidemiology, incidence and mortality worldwide and in Europe

Cancer is one of the most frequent causes of death worldwide; in 2020, an estimated 19.3 million new cancer cases and nearly 10 million deaths from the disease have been recorded (Sung et al., 2021).

Cancer is the second most important cause of death and morbidity in Europe; the first are circulatory diseases (OECD & European Union, 2020). The estimated age-standardized incidence rates of cancer in Europe in 2020 reveals that Ireland is the country with the highest number of new cases this year (372.8 cases per 100,000 people), followed by Denmark (351.1), The Netherlands (349.6), Belgium (349.2), France (341.9) and Hungary (338.2) (IARC, 2020). When we consider the estimated age-standardized mortality rates in the continent, we see that Serbia is in first place (151.7 per 100,000 people), followed by Hungary (149.0), Montenegro (145.2), Slovakia (141.3), Poland (137.5) and Croatia (133.3) (IARC, 2020). The total number of cancer cases is estimated to be around 2.7 million (all types, excluding non-melanoma skin cancer) and 1.3 million deaths in 2020 (Cattaneo, 2020). We can observe a difference between the incidence and mortality of cancer in Europe in relation to the region. Although many of the countries with the highest incidence are in the west of the continent, the highest mortality rates are concentrated in Central and Eastern Europe.

### Female breast cancer worldwide and in Europe

In 2020, female breast cancer is the most diagnosed type of cancer among women in 158 countries worldwide (IARC, 2020). In 2020, there were 2.3 million women diagnosed with breast cancer and 685,000 deaths globally and by the end of 2020 there were 7.8 million women who received a breast cancer diagnosis in the past 5 years, making it the world's most frequent type of cancer (World Health Organization, 2021).

Nearly 50% of breast cancers develop in women over 40 years old with no other identifiable risk factors; however, some behaviours or characteristics may increase the risk of breast cancer, such as obesity, family history of the disease, use of alcohol, exposure to radiation, post menopause hormonal therapy and tobacco use (World Health Organization, 2021).

Female breast cancer is the most commonly diagnosed cancer in Europe in 2020 (with an estimation of 13.3% of all cancer diagnoses, or 355,000 women), followed by colorectal (341,000, 12.7%), prostate (336,000, 12.5%) and lung cancer (318,000, 11.9%); the cancers that cause the highest mortality rates in the continent are lung (20.4% of all cancer deaths), followed by colorectal (12.4%), female breast cancer (7.3%) and pancreatic cancer (7.1%) (Cattaneo, 2020). The vast majority of these deaths occur among people aged over 65 (OECD & European Union, 2020). Tobacco consumption and excessive alcohol consumption cause about 40% of the total cancer burden (World Health Organization, 2020).

## Importance of prevention and early detection of breast cancer

Despite the expectation of an increase in cancer cases in the coming decades, it is important to reiterate that changes in the population's lifestyle and habits can reduce the likelihood of the disease onset.

Breast cancer often shows no symptoms in its early phases, and for this reason many cases are detected at more advanced stages, when the chances of cure are lower (Milosevic et al., 2018). Early-stage cancers are easier to treat than later-stage cancers, and this is why routine screening lowers the risk of death by breast cancer (Jin, 2014). More than 90% of women diagnosed with breast cancer at the earliest stages (stages 0 and I) survive for at least five years compared to around 15% for women diagnosed with the most advanced, metastatic stage of disease (stage IV) (Cancer Research UK, 2018).

Despite the importance of screening tests and prevention measures, the rate of adherence to examinations to detect breast cancer in several European countries is low. For instance, in countries such as Hungary, Cyprus, Slovakia and Bulgaria, the proportion of women aged 50-69 years who had undergone a mammogram examination was below 40% in 2016 and 2017; and seven European Union member states had screening rates below 50% (Gaál, 2020).

One step to change this scenario is correctly informing the population about the importance of early diagnosis, prevention, risk factors and screening exams. The literature shows there is an urgent need for awareness, which includes and engages some marginalized groups in society (Akram et al., 2017; Islam et al., 2016; Újhelyi et al., 2018).

## Rise and growth of social media

It is known that the Internet is considered an important tool for the information search and decision-making in the health area (Moorhead et al., 2013; Strekalova & Krieger, 2017). Social media, that is, websites that allow communication and information sharing among users, are a promising ground for communication about health and breast cancer. The number of users of social media does not stop growing worldwide. In 2017, more than 2.8 billion people were using social media all around the globe, a number projected to increase to almost 4.41 billion in 2025, approximately half of the world population (Statista, 2020).

A growing number of individuals use social media as a source of information. In an extensive survey conducted in 2020, nearly 65% of respondents from populous countries such as Mexico, Argentina, Kenya, South Africa, Philippines and Brazil, declared they rely on social media as a source of news (Biancovilli, Makszin, & Csongor, 2021).

## Health and cancer communication on social media

According to data from 2021, 55% of EU citizens aged 16-74 declared they search for health information online in topics such as nutrition, disease, and health improvement, among others; in 2010, the number was 34% (Eurostat, 2021). The highest shares were recorded in Finland (77%), The Netherlands (76%), Denmark (72%) and Germany (70%); on the other hand, the lowest rates in the EU are in Romania (28%), Bulgaria (29%), Italy (35%; 2019 data) and Poland (43%); Hungary is above the EU average (62%) (Eurostat, 2021). In a large-scale study conducted in France, it was found that the individuals who most seek health information online are younger women with higher than average educational level, higher than average household income, and having a chronic disease (Ducrot et al., 2021).

A systematic review dedicated to analysing social media interventions for cancer prevention shows that the main topics were cancer prevention education and social support, such as using chatting rooms and sharing videos/photos of their personal experiences with cancer (Han et al., 2018). Nevertheless, in most cases there was no scientific quality verification of the shared content, which can make room for misinformation sharing. The most frequently used social media platforms for the interventions were Facebook, blogs, YouTube, and Twitter.

Another research was devoted to understanding how parents of children with acute lymphoblastic leukaemia use their personal Facebook pages for cancer-related communication (Gage-Bouchard et al., 2017). Their results show that six main themes emerged, which are:

> (1) documenting the cancer journey, (2) sharing emotional strain associated with caregiving, (3) promoting awareness and advocacy about pediatric cancer, (4) fundraising, (5) mobilizing support, and (6) expressing gratitude for support. (Gage-Bouchard et al., 2017, results section).

That is, in addition to documenting their personal experiences, these platforms are also used to share knowledge about paediatric cancers and promote advocacy, which is positive.

**Breast cancer on social media and Breast Cancer Awareness Month**

As it is one of the most frequent types of cancer worldwide, several studies are dedicated to analysing the discourse related to breast cancer on social media. One systematic review investigated the breast cancer screening discourse on those media (Döbrössy et al., 2020). They observed that most of the discourses are produced by lay individuals, and there is a scarcity in the healthcare professionals' participation on these discussions. Regarding the most shared content, the prevailing sentiment towards screening ranges from neutral to favourable, and some of the main topics discussed include the changing of screening age recommendations in the U.S. and mammographic efficacy.

A scoping review about general breast cancer communication on social media (Shetty et al., 2021) concluded that there are four main themes among the online discussions: (a) Raising awareness, for instance with information sharing about screening and treatment options (b) social support, by providing cancer patients with guidance and emotional sustenance (c) reliability, which refers to trust and concerns about the quality of the information received and (d) others, which includes prevention, access to cancer centres and online privacy, for example.

October is in numerous countries worldwide the Breast Cancer Awareness Month (BCAM), an international health campaign launched in 1985 by the American Cancer Society and Imperial Chemical Industries in the United States (Moss, 2021), which aims to increase awareness of the disease, informing the population about the importance of mammography, self-examination, symptoms and encouraging donations and emotional support for breast cancer patients (Glynn et al., 2011). One study examined the Internet Search Interest (ISI), that is, Google Internet searches, for the terms "breast cancer" and "mammogram" in the United States. They found out that ISI was 2.34 times higher during BCAM in comparison with other months. This is a good indication that, at least in this geographic region, the awareness campaign has positive results in increasing public interest in relation to the disease and screening tests.

## Misinformation on health and breast cancer

Current debates point to the need for greater concern with the health content that is shared on social media, as this can have direct consequences on the health status of populations (Reidy et al., 2019). Individuals who are in the habit of using social networks or mobile phone applications to search for health information, as a rule, do not confirm the accuracy of the data they find with health professionals; among those who do, health professionals disagree with information on social networks in 36.7% of cases (Crilly et al., 2019). Vaccine misinformation, to mention an example, is a common concern. Vaccine deniers' arguments against child vaccination are widespread on social media (Klimiuk et al., 2021). Therefore, it is important that health professionals and science communicators have a stronger presence on social networks with evidence-based and reliable content that is attractive to the lay population.

The same logic applies when it comes to online communication about breast cancer. Most participants in breast cancer related online conversations are lay people, and they are responsible for the majority of shared misinformation (Döbrössy et al., 2020). On Pinterest, a social network dedicated to sharing images and texts, more than half of the content published about breast cancer (51.1%) contained some kind of misinformation, mostly about foods that allegedly prevent or treat cancer, or that hypothetically cause cancer (Wilner & Holton, 2020).

## Importance of health professionals' presence on social media

Not many studies address the importance of health professionals and science & health communicators dialoguing not only with people who are undergoing treatments, but also with the general population, avoiding the dissemination of false and misleading content. In addition, we believe it is important for these professionals to use online platforms to establish direct communication with the lay public, educating them in relation to health topics with reliable resources.

A qualitative study on social media use by health professionals from the U.S. (Bautista et al., 2021) shows that they do have an online presence (especially Twitter, for professional purposes and Facebook, for both private and professional reasons); and they use social media to correct health misinformation through acts of authentication (verification of the content) followed by acts of correction (priming and rebuttal).

## Significance, aims of this research and research questions

The first aim of this study is to comprehensively analyse news stories about breast cancer shared on social media. Our goal is to identify the main characteristics regarding the narratives in our sample, including the scientific credibility of the content with more public engagement. To our knowledge, despite the substantial number of studies about online health and cancer misinformation, this is the first investigation dedicated exclusively towards effectively analysing breast cancer content across the most used social media worldwide. Our research questions are:

**RQ1.** What is the credibility of the content and the characteristics of the breast cancer news stories on social media that generates more engagement (in the form of total shares)?

**RQ2.** Are there any differences between the content shared in October (Breast Cancer Awareness Month) and other months of the year?

The second part of this thesis is dedicated to the analysis of a questionnaire applied to healthcare professionals across Hungary. Since we believe that the presence of health

professionals producing reliable content about health and breast cancer in social media is extremely important, we interviewed some of these professionals to understand if they work with it, what topics they address and how they dialogue with patients who present them with misleading content. Again, to our knowledge, there are no other studies in Hungary that analyse online medical content in this light. The research questions related to this part of the study are:

**RQ3.** Do Hungarian physicians, health professionals and researchers on cancer use social media to search, consume and produce information on health and breast cancer? If so, how?

**RQ4.** What do these professionals think of the available content on breast cancer, and what are their suggestions on how this content can be improved?

**RQ5.** How do health professionals assess the health literacy of their patients, and how this can be improved?

## METHODOLOGY

### Social media analysis

This is an exploratory quali-quantitative study, without prior hypotheses. We investigated news stories in English which addressed breast cancer. Data collection was conducted between 17 June 2019 and 17 June 2020.

We used an online tool called BuzzSumo (BuzzSumo, 2021) to compile the news stories from our sample. This tool has a large index of social media engagement data, comprising more than 5 billion articles. Users are able to discover the most popular content in any niche, by typing the topic of interest in the search tool. With this, it is possible to find meaningful insights based on what content is shared out on social media the most.

We searched for the keyword "breast cancer", in quotation marks, so that we only have results displaying this exact term, and not the words separately. The search was made within the "Web Content" tab, which lists and displays metrics of the most engaging articles, videos, and blog posts among the following social media sites: Facebook, Twitter, Pinterest and Reddit. Our search was limited to pages in English, with no country restrictions. We performed statistical and content analysis of the stories which had at least 1,000 total shares. The news stories filtered by BuzzSumo were exported to an Excel table containing the following information: total shares (sum of shares, that is, when users share content on their personal pages, across all analysed social networks); total Facebook shares; Twitter shares; Pinterest shares; total Reddit engagements; and published date.

### Content analysis

The content analysis follows the methodology developed by Bardin (Bardin, 2013), which is an inductive analysis comprising of the steps listed:

**1. Pre-analysis:** In this step, the research objectives are defined, and the universe of the study is demarcated. This universe, called *corpus*, is the set of documents considered to be submitted to analytical procedures (Bardin, 2013). After the *corpus* definition, we implement a wide and careful reading of all the material.

**2. Coding:** This phase consists of a transformation - carried out according to precise rules - of the raw data of the text, transforming this by aggregation and enumeration, which allows the analysts to reach a representation of the content (Bardin, 2013). In this step, we created the

coding schedule for this research, which is the form in which all the data relative to the news stories being coded will be entered (see **Table 1)**.

**3. Categorization:** At this stage, every unit of the corpus is classified in groups that present similarities. Each news story was considered by us as a unit of the *corpus*. In this way, we used different dimensions to categorize each column of the coding schedule (**Table 1)**. Two researchers performed the analysis of the material and its classification. The coding schedule and its dimensions were previously determined by both. Afterwards, the analysis of a sample of one hundred news stories was carried out separately by each of the researchers. Percent agreement was used to calculate inter-rater reliability, and the result is 83%. After analysing this initial sample, one of the researchers concluded the categorization of the entire *corpus* (Biancovilli, Makszin, & Csongor, 2021).

**4. Interpretation:** This stage is when the analysts can make inferences from the *corpus* and evaluate its results. The focal point of the analysis can be the sender (or producer of the message); the receiver; the message and the medium. In this study, we chose to analyse the content through the message, which encompasses the code (in this case, the words) and the meanings that the message provides.

**Table 1. Coding manual, comprising the coding schedule (the column headings indicate the dimensions to be coded) and its categories.**

| Credibility | Type of rumour | Source of news stories | Content type | Mentions breast cancer prevention? | Mentions early detection or screening exams? | Sentiment | Mentions symptoms? | Mentions risk factors? | Mentions a scientific paper or quotes a specialist? | Celebrity presence? |
|---|---|---|---|---|---|---|---|---|---|---|
| Verified | Misleading | Traditional media | Real-life story | Yes | Yes | Positive | Yes | Yes | Yes | Yes |
| Rumour | False connection/context | Digital media | Risk factors | No | No | Negative | No | No | No | No |
| | Fabricated content | | Treatment | | | Neutral | | | | |
| | Satire | | New technology | | | | | | | |
| | | | Solidarity | | | | | | | |
| | | | Educational | | | | | | | |
| | | | Complaint | | | | | | | |
| | | | Opinion | | | | | | | |

**Pink October – Breast Cancer Awareness Month**

Another dimension analysed in our sample is the content produced during the month of October compared to the other months of the year. Every October marks the Breast Cancer Awareness Month, a worldwide campaign that has the aim to celebrate new research into prevention, diagnosis, and treatment, as well as to make everyone aware of the importance of knowing the symptoms, performing the screening exams and knowing the importance of early diagnosis (Karabay et al., 2018).

**Questionnaire - Hungarian doctors, health professionals and cancer researchers' attitudes towards online health communication on breast cancer**

The presence of healthcare professionals and communicators in the online sphere goes beyond the traditional doctor-patient relationship. The COVID-19 pandemic showed us that quality and evidence-based content about the disease needs to be available to as many people as possible, in a clear and accessible language, thus avoiding as much as possible the dissemination of misinformation that can indirectly lead to deaths (Biancovilli, Makszin, & Jurberg, 2021; Li et al., 2020).

**Ethics approval**

The study has an ETT TUKEB (Hungarian Medical Research Council - Tudományos és Kutatásetikai Bizottság) professional-ethical license: IV/9147-2/2020/EKU. This research is authorized for the entire territory of Hungary. The investigation conforms to the principles outlined in the Declaration of Helsinki.

**Development of the questionnaire**

The semi-structured questionnaire was developed based on another validated survey (with some modifications) which aimed to provide a national profile of Australian doctors' attitudes towards the use of online social media. (Brown et al., 2014). The research questionnaire comprises of 27 questions in total, 17 closed-ended and 10 open-ended questions, all in English language. A first version of the questionnaire was used as a pilot, in a sample of 10 participants. Subsequently, this draft questionnaire was revised by three scientists from different backgrounds before we reached our final version: one sociologist, one anthropologist and one linguist.

Sociodemographic characteristics were obtained by using questions regarding age, nationality, gender, highest academic degree, medical specialty (if any), marital status, county where they work, and years of experience in the medical field. Subsequently, the next section of the questionnaire aimed at investigating if and how health professionals consume breast cancer information on the Internet, what exactly this content is about and what type of media they use (i.e., online newspapers, academic journals, social media). Then, the next section of the questionnaire focused on understanding doctors and researcher's science outreach activities on social media. Finally, the last section was answered only by physicians or other professionals who work directly with breast cancer patients, and they should express their opinions on the health literacy of the patients regarding breast cancer (if their patients have ever reported believing in misinformation related to breast cancer and what are the professionals' attitudes when this happens). Before answering the questionnaire, participants were provided an informed consent, containing the objective of the research, the contact of the responsible researchers, the information that all data collected is anonymous and confidential, as well as the estimated time to answer the survey, which is 10 minutes. The participation was voluntary and there were no incentives offered.

**Participants and recruitment process**

This is a cross-sectional study with a convenience sample. The survey is online based, and we used Google Forms tool to make it available for the users. Since this research was produced during the COVID-19 pandemic, we were unable to organize focus groups or face-to-face interviews in hospitals or medical laboratories, as this would pose a health risk. Therefore, a

web-based survey was ideal in this context. We contacted potential participants via e-mail. Data collection took place from June 2021 to November 2021.

### Open-ended responses analysis

All answers to open-ended questions were organized and scrutinised using the content analysis software Atlas.ti 7 Scientific Software Development GmbH. We created codes that could represent the complexity and nuances of the written responses, also using Bardin's methodology (Bardin, 2013) previously mentioned.

### Statistical analysis

Data were analysed using IBM SPSS Statistics V20, Minitab 16 and Microsoft Excel 2010. To characterize the distribution of the relative frequency (percentages or prevalence) of the qualitative questions, the test for equality of two proportions was used. For bivariate analyses between quantitative and qualitative factors, the ANOVA test was used, and for comparisons among qualitative questions, we performed the chi-square test.

## RESULTS

### Social media content analysis

Screening the media for breast cancer news stories published between June 2019 and June 2020 resulted in 9,811 hits. Of these, 1,594 news stories had at least 1,000 total shares.

### Source of news stories

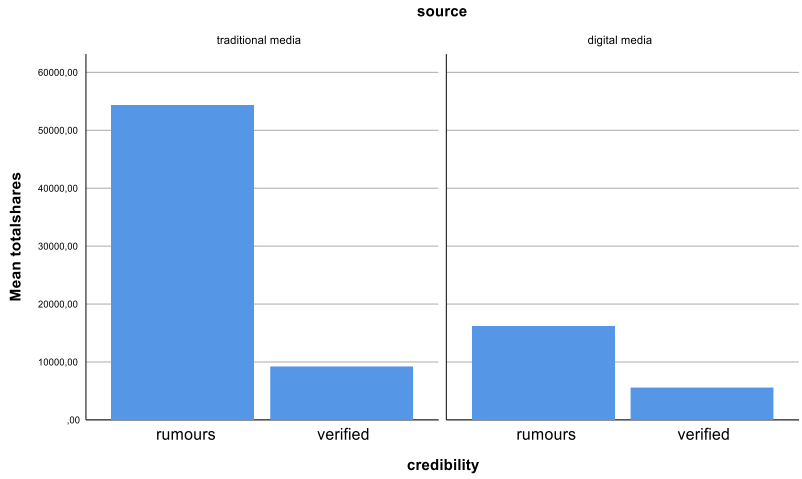
Regarding RQ1, most of the stories in our sample were published in digital media (76.73%), whereas 23.27% originated from traditional media.

### Credibility analysis

Among the news stories selected for coding, 69.7% have not been classified according to credibility. This is because these news items do not address science, risk factors, prevention, treatment or other aspects, which can be assessed for scientific accuracy. Considering only the news classified according to credibility (n = 483), 17.25% are 'verified' and 13.05% are 'rumours'.

When we investigate the number of shares in relation to the credibility of the content (Fig. 1), we can note that the content classified as "rumours" tends to be more shared than scientifically correct content, both in digital and traditional media. “Rumours” is less frequent in our sample but totalled 5,755,192 shares. Meanwhile, the “verified” stories had 1,747,352 total shares (3.29 times less).

**Figure 1. Mean of total shares of content classified as 'verified' and 'rumours' both in traditional and digital media.**




## Type of rumour

When we examine the most common types of rumours, we see 'false connection/context' represent 62.7% of the total, 'misleading content' are 34.9% of the total, and totally false content, that is, 'fabricated content' category, represents 2.4% of the total.

## Content type

When we examine the distribution of content type categories in our sample, we see most stories are classified as 'real-life story' or 'solidarity' (67.69%). These stories have no scientific content, since they are focused on narrating the life of an individual or family members with cancer, publicizing actions to raise money for cancer hospitals or requesting donations of any kind for patients in need, to mention a few examples.

## Mentions of breast cancer prevention and early detection/screening exams

Most analysed news stories do not address ways of preventing or early detecting breast cancer. In our sample, 5.08% of the stories comment on prevention and 19.7% mention early detection. There is an extraordinarily strong statistical connection (Cramer's value = 0.435; Fisher's exact test, $p < 0.001$) between content type and prevention; and between content type and early detection (Cramer's value = 0.355; Chi-square test: $p < 0.001$).

Of the 30.3% of the news stories that could be classified according to credibility (n=483), a total of 45 (9.3%) are scientifically verified and mention breast cancer prevention measures. However, the vast majority of verified stories (n=230 or 47.61%) do not address this topic. Stories classified as rumours showed a similar pattern, as 23 (4.76%) mention prevention and 185 (38.3%) do not.

## Sentiment analysis

There is a balance in relation to sentiments in our sample. 37.83% are positive, 25.35% are neutral and 36.83% are negative. When we cross the different dimensions of our content analysis, we can see one aspect that stands out, and that is the high number of total shares of positive news stories whose content type is "treatment". Second to total shares, we see stories

with negative content about "risk factors" and thirdly, with a similar number of total shares, are positive stories about "educational" topics and negative stories about "real-life stories".

**Mentions of symptoms**

In our sample, 1354 of the news stories (84.94%) do not mention any type of breast cancer symptoms, whereas 240 (15.05%) do. There is a very strong connection between content type and mentions of symptoms (Chi-square test: $p<0.001$; Cramer's value=0.281).

**Mentions of risk factors**

Regarding risk factors for breast cancer, 228 news stories mention it (14.30%), whereas 1366 (85.7%) do not refer to this topic. There is a very strong statistical connection between content type and mentions to risk factors (Chi-square test: $p<0.001$; Cramer's value=0.820).

**Mentions of scientific papers or specialist quotes**

Most of the news stories in our sample do not mention a scientific paper or quote a specialist (n=1095, 68.69%). There is a very strong statistical connection between content type and mentions to scientific paper/specialist quote (Chi-square test: $p<0.001$; Cramer's value=0.774).

**Celebrity presence**

In the Top 20 most shared stories of our sample we also noticed a highlight in news that addresses celebrities with breast cancer (n=4), including the North-American actress Shannen Doherty, the British-Australian singer Olivia Newton-John, and the North-American television broadcaster Robin Roberts. In total, 262 news stories mention a celebrity (16.44%), whereas 1332 stories do not (83.56%).

There is a very strong connection (Chi-square test: $p<0.001$; Cramer's value=0.293) between content type and celebrity presence. However, the connection between source of news and celebrity presence (Table 16) is weak (Chi-square test: $p=0.017$; Cramer's value=0.060). Most of the news stories in our sample are neutral and have no celebrity presence. In relation to credibility, most stories cannot be classified according to it, as they do not mention aspects that can be assessed for scientific accuracy. There is a very strong statistical connection (Chi-square test: $p<0.001$; Cramer's value=0.300) between celebrity presence and sentiment. We can observe a considerable higher proportion of negative news stories with celebrity presence (53.82% *versus* 19.74%), in comparison with stories without celebrities.

**Breast cancer awareness month**

To answer RQ2, we compared the content of the news published in October (known as the "Breast Cancer Awareness Month" or "Pink October" in a number of countries worldwide) (Glynn et al., 2011) with the other months.

There is a substantial upsurge in news stories classified as "solidarity" in October (28.4% versus 9.3% in other months). In contrast, there was a decline in content that addresses "risk factors" (3.6% versus 13.1% in other months), "real-life stories" (47.9% versus 54.5% in other months) and "technology" (1.0% versus 7.0% in other months). We can observe a slight increase in educational content (7.8% versus 5.3%).

By comparing the reliability of the news stories shared in October with the other months of the year, we see there is a statistically significant difference in the distribution of the types of rumours (Fisher's exact test: $p = 0.030$; Cramer's value = 0.172, strong connection). There is

an upsurge in rumours classified as "false connection/context" (81.3% in October versus 59.3% in other months), whereas it is possible to note a decrease in “misleading content” (15.6% in October versus 38.4% in other months).

## Questionnaire results

### Basic demographics

Regarding age, most of respondents (33.3%) are between 31-40 years old and 51-60 (28.2%). The majority of respondents are Hungarian (74.4%), female (53.8%), married (66.7%) and work in Budapest or Pest county (56.4%).

### How respondents search, consume and appraise information about breast cancer on the Internet

Regarding RQ3, when asked “Do you use the internet to read news related to breast cancer (both news on media outlets aimed at the general public, or latest research results in academic journals)?”, 84.6% answered “yes” and 15.4% answered “no” ($p<0.001$). The most cited online pages which respondents visit to consume information about breast cancer are Medscape (25%), PubMed (22.2%) and scientific journals (11.1%).

To answer RQ4, we have also asked if respondents knew any science communicators who address the topic breast cancer on social media, for that 69.2% answered “yes” and 20.8% answered “no”. Among those who answered yes, we asked them to mention which platforms are used by these science communicators, and how they evaluate the work of these professionals. Table 2 shows us the result of this cross-analysis.

**Table 2. How respondents rate the work of breast cancer health communicators on social media (from 0 to 10), according to the social media.**

| | Average | Median | SD | N | CI | P-value |
|---|---|---|---|---|---|---|
| Facebook | 8.0 | 8 | 2.1 | 5 | 1.9 | 0.271 |
| LinkedIn | 6.2 | 5 | 1.6 | 5 | 1.4 | |
| Other | 6.3 | 6 | 0.5 | 4 | 0.5 | |
| Research Gate or Academia | 7.4 | 7 | 1.7 | 5 | 1.5 | |
| YouTube | 7.8 | 8 | 1.5 | 6 | 1.2 | |

### Do health professionals who work in Hungary disseminate science on social media?

We asked healthcare professionals the following question: "Have you ever done any work to communicate science to the general public on social networks/blogs/newspapers?”. It is important to note that, here, we are not necessarily asking about breast cancer, but science in general. To that, 53.8% answered “yes” and 46.2% answered “no” ($p=0.497$).

When we asked what subjects they covered, the answers were varied. Three health professionals mentioned "anticancer treatments" (21.4%) and two responded "early detection"

[of cancer] (14.3%). The other answers were mentioned only once each (7.7%), and these are: bleeding disorders, cancer genetics, cancer prevention, epidemiology of cancer, gastrointestinal oncology, genitourinary oncology, HIV, HPV prevention, irradiation, medical sociology, molecular biology, nutrition, paediatric cancers, radiotherapy, radiotherapy physics, screening, tumour angiogenesis, tumour appropriation of pre-existing vessels.

**Doctor-patient communication: How to deal with misinformation brought by breast cancer patients**

Regarding RQ5, among the respondents, 35.9% deal directly with breast cancer patients in their work routine, and 64.1% do not (p=0.013). Moreover, 23.1% work directly with people who undergo preventive breast cancer screening exams, and 76.9% do not (p<0.001). Seven respondents mentioned what type of misinformation they have already heard from patients, for example: Mammography causes breast cancer, surgery disseminates the breast cancer, cytostatic kills the patient, radiotherapy accelerates the growth of the cancer, cancer is not curable.

When asked "How do you deal with patients who believe false information regarding breast cancer", 86.9% mentioned they tell the patient the scientific truth; 21.7% show patients reliable sources on the Internet; 17.4% show patients reliable sources out of the Internet; 8.7% ask for the help of a family member or friend to clarify the truth; 4.3% don't argue, because it is no use.

The last question of the survey was open-ended: "In your opinion, what can be done to increase people's awareness of the importance of prevention + early detection of breast cancer?". Answers were also grouped into themes (table 3) that reflect the main ideas regarding each part of the response.

**Table 3. Responses given to the answer „In your opinion, what can be done to increase people's awareness of the importance of prevention + early detection of breast cancer?" grouped into themes.**

| Themes | N | % | p-value |
|---|---|---|---|
| Education | 21 | 58.3% | Ref. |
| Dissemination in the media | 15 | 41.7% | 0.157 |
| Awareness campaigns | 8 | 22.2% | 0.002 |
| Access to healthcare | 4 | 11.1% | <0.001 |
| Transformation in healthcare | 2 | 5.6% | <0.001 |
| Better doctor-patient communication | 1 | 2.8% | <0.001 |
| Better work conditions for doctors | 1 | 2.8% | <0.001 |

After that, respondents had to justify the grade, through an open question. The answers were categorized and analysed (**Table 4**) according to the theme that best fit them.

**Table 4. Justifications for the grade given to the health literacy of patients in relation to breast cancer, grouped by theme.**

| Themes | N | % | P-value |
|---|---|---|---|
| No knowledge on prevention | 7 | 50.0% | Ref. |
| No knowledge on symptoms | 6 | 42.9% | 0.705 |
| No knowledge on screening | 3 | 21.4% | 0.115 |
| Knowledge on screening | 2 | 14.3% | 0.043 |
| Ignore screening | 1 | 7.1% | 0.012 |
| Knowledge level can vary | 1 | 7.1% | 0.012 |
| Knowledge on genetic patterns | 1 | 7.1% | 0.012 |
| Knowledge on symptoms | 1 | 7.1% | 0.012 |

Half of those who answered this question reported that their patients lack knowledge regarding cancer prevention, and 42.9% are unaware of the symptoms of breast cancer. In addition, 21.4% do not know when or how screening tests are performed, especially mammography. This majority of negative responses in relation to patients' health literacy is a justification for the relatively low average score given to patients on the topic (4.68). The positive response regarding patients' health literacy, which is "knowledge on screening", was mentioned twice by health professionals, or 14.3%. The other positive remarks regarding patients' knowledge about breast cancer were mentioned once each (“knowledge on genetic patterns” and “knowledge on symptoms”).

## DISCUSSION

### Credibility analysis, type of rumour and source of news stories

It is important to note that the news classified as "rumours" (13.05%) had a total number of shares 3.29 times greater than the "verified" ones (17.25%). This trend has previously been observed. In a study that evaluated the accuracy of the most popular articles on social media relating to genitourinary malignancies (Alsyouf et al., 2019), there was a significantly higher average number of shares for inaccurate and misleading articles, compared to accurate ones. The same tendency was observed in a study dedicated to examining the spread of information related to Zika virus on the Internet (Sommariva et al., 2018). A study on false news about the COVID-19 pandemic shows us similar results (Pulido Rodríguez et al., 2020).

Most "rumours" in the news stories from our sample did not display completely fabricated information, but instead presented “false connection/context” (62.7%) or “misleading content” (34.9%). Being aware of this nuance regarding misinformation about breast cancer on social media is important. Valid information taken out of context can have even greater potential damage, as it may seem far more convincing to the lay reader—hence the higher number of total shares. This trend has also been observed in other studies. One study about medical misinformation in social media reveals that 40% of the most frequently shared links contained false information, and these were shared more than 450,000 times in a period of five years (Waszak et al., 2018). Another investigation on Twitter content reported that “false news reached more people than the truth; the top 1% of false news cascades diffused to between

1,000 and 100,000 people, whereas the truth rarely diffused to more than 1,000 people" (Vosoughi et al., 2018).

Regarding the source of the news stories, most of the stories in our sample were published in digital media (76.73%), whereas 23.27% originated from traditional media. However, traditional media had a total of 9,113,951 shares, whereas digital media had a total of 7,075,117. The considerably higher number of shares in the content conveyed by traditional media is not in line with the literature on the subject (Sommariva et al., 2018), which is still limited.

We believe that this may have to do with the fact that the information transmitted by traditional media, in our sample, is repeated many times identically or with little change. For example, FOX News has different websites for each region of the United States, and these often propagate the same news stories. In addition, there is also the possibility that users of social networks feel more comfortable in sharing content from traditional media, since these are better known and undergo an editorial process before being published.

**Content type**

The most shared "content types" in the sample of this study were "real-life stories" and "solidarity" (67.69%). This seems to indicate a public preference in relation to these themes. Another study which examined Brazilian Facebook pages about cancer shows similar findings; on most pages, content related to "Solidarity", "Anniversaries" and "Testimonies or real-life stories" was among those with the most engagement on this social media (Biancovilli & Jurberg, 2018).

We cannot fail to mention the fact that, in this sample, the types of content that generated greater public engagement in the form of "total shares" (sum of shares in all social networks analysed) do not correspond to the most frequent content. That is, the seemingly most attractive content is produced on a considerably smaller scale than other content. In this sample, more than half of the content is classified as "real life story" (52.5%). However, the theme that generates the greatest engagement, in much larger numbers, is "treatment", which corresponds to only 9.7% of our total sample. In an analysis produced with Brazilian Portuguese cancer pages on Facebook (Biancovilli & Jurberg, 2018), the same trend was observed.

**Mentions of breast cancer prevention and early detection/screening exams**

No more than 5.08% of the articles in our sample focus on prevention, and 19.7% mention early detection. Broad literature emphasizes the importance of adopting habits that help prevent breast cancer, such as not smoking, limiting alcohol consumption, avoiding a sedentary lifestyle and maintaining a healthy weight (Britt et al., 2020; Mayo Clinic, 2021; Sauter, 2018). It is also particularly crucial that the population is well informed about the importance of early diagnosis, including the symptoms of the disease, as screening is proven to be the most efficient way to diagnose breast cancer at an early stage, decreasing mortality rates (Cancer Research UK, 2015b). Furthermore, a study conducted in Hungary revealed most respondents were unaware of the fact that breast cancer self-examination should be initiated two decades earlier than mammography, when women turn twenty years old (Reményi Kissné et al., 2021). In this same study, it was also shown that both laywomen and screening attendees had insufficient knowledge of the signs and symptoms of breast cancer; lumps are a well-known symptom among surveyed Hungarian respondents, but only 50% of them knew that mamillar discharge can also be a warning sign.

**Sentiment analysis**

Regarding the sentiment analysis, the most shared news stories in our sample are those related to "treatment" with a positive content. Second among the most shared positive content stories is the category "educational". On the other hand, the stories with a preponderant negative sentiment that were shared the most are the “risk factors”, and in second place we can see “real-life stories”. A similar trend has been observed in previous investigations (Carrion et al., 2017; Picanço et al., 2018).

However, our analysis partially diverges from another study that investigated what makes content go viral on the Internet. According to the results of this analysis, positive content is more viral than negative content, but virality is to some extent motivated by physiological arousal – that is, content that evokes high-arousal feelings, be them positive or negative, tend to be more viral (Berger & Milkman, 2012). Another study on video ad sharing in social media platforms revealed that “positive emotions of amusement, excitement, inspiration, and warmth positively affect sharing” (Tellis et al., 2019).

**Mentions of prevention, early detection, symptoms, risk factors, scientific paper or specialist quotes**

In our sample, 94.92% of the news stories do not address prevention, 80.3% do not mention early detection, 84.94% do not mention symptoms, 85.7% do not refer to risk factors and 68.69% do not quote a specialist or link a scientific paper. As if that were not enough, part of the content that mentions these themes is not backed by science, which can give rise to risky behaviour or refusal to conventional medicine. Literature on health misinformation in social media identifies a considerable amount of vaccine and cancer-related false information, including unproven natural cures for cancer and other diseases (Poulose, 2021). An investigation conducted in 2019 reveals that cancer was the most popular topic of health misinformation online that year, with many articles citing marijuana as a natural way of curing cancer (which is unproven by science); moreover, an article that was engaged more than 800 thousand times is entitled “Ginger is 10,000x more effective at killing cancer than chemo”, another unscientific claim (Zadrozny, 2019).

A study dedicated to analyse breast cancer screening content on Twitter reveals that publications frequently contain claims that are false, “not explicitly backed by scientific evidence, and in favour of alternative “natural” breast cancer prevention and treatment” (Nastasi et al., 2018).

**Celebrity presence**

It is worth mentioning the fact that, in our sample, most stories involving a celebrity have negative sentiment (53%). In contrast, in stories that do not mention celebrities, this number is much lower (19.7%). As mentioned earlier, the most shared theme in our sample is related to treatment, with a positive sentiment. Messages and posts that generate positive feelings in the audience tend to be more popular on social media. Therefore, we believe that an improvement in this regard could include the more frequent use of celebrities to address topics considered optimistic, such as treatments, latest developments in science, or real stories of hope and motivation, just to name a few examples.

A good example found in the sample is the article titled “Angelina Jolie’s Doctor Launches Pro-Vegan Breast Cancer Awareness Campaign”. It mentions a worldwide famous celebrity, the North-American actress Angelina Jolie, quotes a specialist, which is her breast cancer

doctor, has a positive sentiment by mentioning good, evidence-based ways to prevent breast cancer: “Healthful foods from plants (vegetables, fruits, whole grains, and beans) lower breast cancer risk in several ways. They help with weight loss, because they are typically low in calories and high in appetite-taming fiber. In addition, high-fiber, low-fat diets can help you gently reduce estrogen levels. In turn, lower estrogen levels can lower your risk of cancer. Plant-based foods are packed with nutrition, and plant-based diets can reduce the risk of multiple diseases. Even so, you’ll want to ensure you get complete nutrition. To do that, include a variety of vegetables, fruits, whole grains and beans in your routine. And be sure to have a reliable source of vitamin B12 daily, such as a simple B12 supplement.”

Recent large-scale studies have verified the effectiveness of a number of strategies to prevent breast cancer, such as low-energy density diets, highly nutritious plant-based regimes, physical activity, and body/abdominal adiposity management (Chang et al., 2017; Penniecook-Sawyers et al., 2016; Shapira, 2017).

Angelina Jolie received media attention in 2013 when she underwent a preventive double mastectomy when she discovered she had the BRCA1 gene, which increases her risk of breast and ovarian cancer. This has triggered all over the world the so-called “Angeline Jolie effect”, which means that by that time the demand for BRCA 1/2 testing increased exponentially, and more women opted for the same type of preventive surgery to reduce the risk of developing breast cancer (Schnipper, 2021). This is just one example of the power that world-renowned celebrities have in influencing health decisions. It is not to imply that the case of Angelina Jolie is absolutely positive, after all it is not a common practice to take a family history of cancer in primary care (Evans et al., 2014), and there is no medical consensus on the usefulness of this surgery (Annadurai et al., 2017).

Nevertheless, numerous studies have shown that the diagnosis of a celebrity with cancer greatly increases public interest in the topic. For instance, in 2011 the Brazilian actor Reynaldo Gianecchini was diagnosed with lymphoma. When his diagnosis was made public, there was a sudden and massive rise in searches for the terms ‘Gianecchini’ and ‘linfoma’ (lymphoma in Portuguese) in Google Brazil, as mentioned in a study about the case (Biancovilli et al., 2015). However, this same study shows that the media gave more attention to the celebrity itself, and did not alert the population sufficiently about the symptoms, risk factors and the development of the disease. It is believed that these cases of celebrities diagnosed with cancer can be used as a hook to raise awareness about prevention, symptoms, types of treatment, risk factors and early detection.

Another example that was investigated by science communicators was the breast cancer diagnosis of the Australian singer Kylie Minogue in 2005. At the time, the singer was at the height of her fame and was only 36 years old, which generated even more commotion; her diagnosis generated the so-called "Kylie effect" in Australia, which is a 40% increase in appointment bookings for mammograms in the two weeks after the diagnosis, plus a 101% increase in mammograms for previously unscreened women in the eligible age group of 40–69 years (S. Chapman et al., 2005). A similar effect was also observed in the United Kingdom (Twine et al., 2006). In Australia, the media made a point of emphasizing the importance of early detection of breast cancer to save lives, which was the case of the artist — journalists emphasized explicitly that vigilance and mammograms were relevant for all women (S. Chapman et al., 2005).

Unlike the case study in question, this news story sample barely addresses early detection/screening exams at the same time as mentioning celebrities. Only 27 (1.69%) out of

1595 news stories do so. One example is the story “Journalist diagnosed with breast cancer while getting mammogram on Facebook Live” (3736 total shares), which tells the case of the North-American journalist Ali Meyer. The article tells her story and is also informative. Some of its excerpts: “Ali's official diagnosis was non-invasive ductal breast cancer. Luckily, it is one of the most survivable forms of breast cancer,” and “Ali reiterates, ‘My surgical options, my recovery, and my outcome were all better because my mammogram found the cancer before I even knew it was there.’ That is the importance of getting your routine mammogram.” We consider this a good example that should be replicated more often.

Another good example is the story “Former NFL star DeAngelo Williams sponsors over 500 mammograms, honors mom who died of breast cancer” (1849 shares). One excerpt says: “Former NFL Pittsburgh Steelers running back DeAngelo Williams’ foundation has sponsored more than 500 mammograms since 2015 to honor his mother who died of breast cancer. The football star began covering the mammogram screenings for women in 2015 through The DeAngelo Williams Foundation, which has sponsored “well over 500 mammograms and have no plans of stopping!” the foundation said in a Facebook post Wednesday.” Although the text does not explain exactly how a mammogram is performed and who should undergo this examination, the mere fact that a celebrity cites the breast cancer screening exam can instigate curiosity in the public to seek more information. However, the ideal would be for the text to already contain more detailed information about it.

**Pink October – Breast Cancer Awareness Month**

We noticed some important changes in the content released in October compared to other months of the year. As mentioned in the results section, there is a considerable increase in news stories whose focus is solidarity (28.4% in October and 9.3% in other months). There is also an increase in stories whose credibility is considered "verified" (69.8% in October x 53.3% in other months).

On the other hand, there is a significant decrease in stories that are more likely to generate some kind of awareness about the importance of prevention and early detection of breast cancer. For example, the frequency of news stories about risk factors considerably decreased in October (3.6% x 13.1% in other months). There was also a slight decrease in educational topics, and we believe that the opposite should have happened. A study conducted in Brazil (Vasconcellos-Silva et al., 2017) observed that there is a significant increment in searches on Google for the terms “breast cancer” and “mammography” (more than 100%) during Pink October awareness month. In Malaysia, the same trend was detected (Mohamad & Kok, 2019).

A study of Twitter usage during awareness month in the United States showed that posts from celebrities were more prominent (in the form of impressions) than posts from anonymous users, and the majority of tweets did not promote any specific preventive behavior (Thackeray et al., 2013). Another investigation conducted in the United States observed that, from January 2004 to December 2009, there was a consistent increase of online activity related to breast cancer, and the October campaign stimulates online activity more effectively than equivalent campaigns for other types of cancer, such as prostate or lung (Glynn et al., 2011).

Social media have an important impact as an education and awareness tool. Moreover, the number of active users on social networks around the world does not stop growing. According to Statista (2020), there were 2.86 billion social network users worldwide in 2017; in 2021, this number raised to 3.78 billion and it will likely reach 4.41 billion in 2025.

It is of great importance to improve the quality of content related to breast cancer during the Pink October. It is necessary to produce more content on preventive behavior and on topics with a positive sentiment that tend to generate a greater number of shares, according to our sample: treatment, educational, technology and real-life story.

**Questionnaire discussion**

In our sample, just under half of the respondents (46.2%) have already used social media to develop science dissemination work. Among those, most used Facebook (38.9%) and YouTube (16.7%) as platforms. Two respondents mentioned they have already used social media to communicate about early detection of breast cancer, and one mentioned cancer prevention. In the sample of news stories, 5.08% of the stories comment on prevention and 19.7% mention early detection. That is, the same trend of low frequency of this type of content was observed in both investigations.

These results may help to justify the main complaint of health professionals who responded to the survey regarding the health literacy of their patients ("no knowledge on prevention", 50%; "No knowledge on symptoms", 42.9%; and "No knowledge on screening", 21.4%). A stronger presence of health professionals on the Internet and social media is of fundamental importance to counter the spread of health misinformation and, at the same time, increase the quality of the content that circulates among users.

A study on the social media use by physicians (Campbell et al., 2016) shows that a considerable number of professionals claim they do not have time to use social networks and produce content regularly, as this would affect their work with patient care. Moreover, others expressed uncertainty about their potential impact and repercussions, and are not sure whether it is a duty of all physicians to provide health information online. "While some participants were insistent that more physicians should be involved, most were equivocal, stating that physicians should only participate if they feel they would enjoy it and are equipped to do so." (Campbell et al., 2016, results section).

The respondents of the survey seem to agree on the importance of a wider use of media (including social media) to communicate with the lay population and cancer patients (as 41.7% of the answers to the question "In your opinion, what can be done to increase people's awareness of the importance of prevention + early detection of breast cancer" mention "dissemination in media" as a suggested solution. The topics "education" and "awareness campaigns", which were mentioned 58.3% and 22.2% respectively are also partially related to the use of social media, as it is one of the possible ways to make educational or awareness campaigns reach more people.

A survey conducted with breast cancer patients showed that more than 50% of respondents have unmet information needs (Schmidt et al., 2016), even though they are in continuous contact with doctors, social service workers, gynaecologists and other healthcare professionals. Most of the unanswered questions are about coping with long-term side effects, follow-up care after acute treatment, and heredity of breast cancer. The reasons for this gap in doctor-patient communication are not entirely clear, but this may motivate patients to seek information about their diagnosis and queries on the Internet and social media. Another study, also with breast cancer patients (Kugbey et al., 2019), showed that access to health information improve quality of life of breast cancer patients, by reducing anxiety and depression levels. The presence of false and misleading information online, therefore, must be considered a problem with a high level of importance.

In the survey, the health literacy score of breast cancer patients was relatively low (average=4,68; median=4), which converges with the scientific literature in the area. “Poor knowledge about breast cancer is known as a main issue for breast cancer screening barriers, delayed treatment, and thus contributes to the high morbidity and mortality rates.” (Rakhshkhorshid et al., 2018).

In a study carried out in the context of the COVID-19 pandemic, which measured and crossed levels of health literacy, mental health and compliance with COVID-19 preventive measures, it was observed that people with higher levels of health literacy suffered less from anxiety, problems of sleep and depression (Hermans et al., 2021).

## CONCLUSIONS

The content analysis of news stories on social networks revealed that, although the volume of verified, evidence-based content is moderately greater in the sample than misinformation, unscientific articles are shared 3.29 times more, on average. No more than 31.31% of the news stories mention scientific papers or quote a specialist. Moreover, 69.7% of the sample have not been classified according to credibility. This is because these news items do not address science, risk factors, prevention, treatment or other aspects, which can be assessed for scientific accuracy.

A greater presence of these themes in online narratives about breast cancer is needed, whether inside or outside social media, to inform the population about treatments, symptoms and early detection in an adequate and consistent way. For this objective to be achieved, it is of fundamental importance that health professionals and science journalists with knowledge in the health area produce scientifically correct and reliable content on social media, dialoguing not only with cancer patients and their families but also with the general population.

Most of the sample is made up of news stories within the themes 'real-life story' (52.5%) and 'solidarity' (15.2%). Furthermore, stories about 'treatment' generated more engagement in the form of shares than any other topics, despite being only 9.7% of the sample. As the cut is composed of the stories with the most shares in a one-year period, it is implied that these are the topics that attract more attention from the general public. It would be interesting, for example, to include information on prevention and early diagnosis in stories of these types. After all, only 5.08% of the stories in the sample comment on prevention and 19.7% mention early detection, including mammography. The same should be done during the Breast Cancer Awareness Month, when there is an increase in internet searches on the topic.

Regarding the questionnaire aimed at health professionals working with cancer in Hungary, it was observed that most of them use the Internet to search for content about science and breast cancer. On the other hand, less than half have already produced any scientific content on social media. Respondents seemed to agree on the importance of a wider use of media (including social media) to communicate with the lay population and cancer patients, and a need for further education on the subject was mentioned repeatedly.

During the COVID-19 pandemic, several studies that address the health literacy of the population and what are the advantages of greater medical knowledge were published. They reveal that higher health literacy is related with lower rates of anxiety and depression. Most likely, the same relationship can be extended to breast cancer patients as well. Knowing better the biology of the disease, treatments, side effects, among other topics, would help people to better deal with the diagnosis. This type of information is also important for the general

population, as if they or a friend/family member are diagnosed with the disease in the future, access to reliable information will help them deal with the treatment in the best possible way.

## LIMITATIONS

This study has some limitations that must be addressed. Firstly, in the content analysis, the limited number of investigated news stories should be noted, as there were not enough resources to analyse qualitatively thousands of articles whilst keeping the quality of the process. Because of this, there is no way of knowing whether the result of the content analysis of the entire corpus will be the same as the analysis of the sample selected for this study. Secondly, is the fact that the sample is limited to news stories in English. If other languages were analysed, variations in the topics covered and in the credibility of the news might have been encountered. Consequently, most likely it is not possible to generalize the results observed in this article to all languages and cultural settings. In addition, we did not analyse social media content in Hungarian, due to the lack of proficiency in the language of the author of this thesis. This fact makes the comparison between the analyses of news stories in English and the responses of health professionals working in Hungary slightly less accurate.

Regarding the questionnaire, an important limitation is the low number of respondents and the fact that it is a convenience sample, which makes the sample non-representative. One factor that affected the outcome of this part of the research was the outbreak of the COVID-19 pandemic, as access to hospitals for direct communication with healthcare professionals became impossible for many months. Another factor is the difficulty, already reported in the literature (Gruppen, 2007), in obtaining sample sizes in the medical field that are generalizable and have statistical power. In the case of this research, the fact that the questionnaire was produced in English was another possible limiting factor for obtaining more answers. A potential solution would be to expand the data collection time, so that it is possible to include the largest possible number of participants and increase the representativeness of the sample.

Nevertheless, the findings of this study may be beneficial to assist in the development of online health communication strategies in breast cancer. Doctors, scientists, and health journalists can develop the dialogue with the lay audience on the topic, countering online misinformation.

## FURTHER PERSPECTIVES

Future directions for the development of this investigation may include:

- Production of content for social media on breast cancer according to the results measured in this investigation. This includes but is not limited to a greater presence of content on prevention and early detection, created by experts from reliable sources, in news stories that narrate "real-life stories" and "solidarity"; production of content that addresses the same themes, using celebrities in positive contexts.

- Another path involves the analysis of breast cancer news stories, using the same methodology, in a different time frame. In this way, it will be possible to compare the two periods and measure similarities and differences.

- It is interesting to analyse online content about breast cancer in other languages and cultural settings, so that the results and consequent communication interventions in social media are tailored according to each environment.

- The continuity of research with health professionals in Hungary is of paramount importance, so that the sample becomes more representative. One possible way is to conduct interviews with these experts, followed by a qualitative analysis of their responses.

- A possible path also includes the elaboration of comparative studies with online materials from different medical fields or different areas of science.

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## SUMMARY OF NOVEL FINDINGS

- To our knowledge, despite the large number of studies regarding online health-related and cancer misinformation, this is the first investigation dedicated exclusively towards effectively analysing breast cancer content across the most used social media sites worldwide.

- Content classified as "rumours" tends to be more shared than scientifically correct content, both in digital and traditional media. “Rumours” is less frequent in the sample but totalled 5,755,192 shares. Meanwhile, the “verified” stories had 1,747,352 total shares (3.29 times less).

- On social media, content about "treatment" tends to generate a considerably greater engagement than other themes (33,854 average shares in the sample). In second place there are news about “real-life stories” (9,205 average shares) and in third place, “risk factors” (7,922 average shares).

- In the studied sample, 5.08% of the stories comment on prevention and 19.7% mention early detection.

- Most of the news stories in the sample are neutral and have no celebrity presence. In relation to credibility, most stories cannot be classified according to it, as they do not mention aspects that can be assessed for scientific accuracy.

- To the best of our knowledge, this is the first study in Hungary that aims to understand doctors, health professionals and cancer researchers’ attitudes towards online health communication on breast cancer. The majority of respondents (84.6%) mentioned they use the internet to read news related to breast cancer.

- When asked “How do you deal with patients who believe false information regarding breast cancer”, 86.9% mentioned they tell the patient the scientific truth; 21.7% show patients reliable sources on the Internet; 17.4% show patients reliable sources out of the Internet; 8.7% ask for the help of a family member or friend to clarify the truth; 4.3% don’t argue, because it is no use. Professionals were also asked to give a grade from 0 to 10 to the health literacy of their patients regarding breast cancer, and the average was 4.68.

- More than half of the respondents (58.3%) mentioned the importance of education as a way to increase the population's health literacy in relation to breast cancer. The respondents of the survey seem to agree on the importance of a wider use of media (including social media) to communicate with the lay population and cancer patients.

## LIST OF PUBLICATIONS

*Articles related to the thesis*

**Biancovilli, P.**, Makszin, L., Amer, F., & Csongor, A. (2022). Celebrities and Breast Cancer: A Multidimensional Quali-Quantitative Analysis of News Stories Shared on Social Media. *International journal of environmental research and public health*, *19*(15), 9676. https://doi.org/10.3390/ijerph19159676

**Biancovilli, P**., Makszin, L., & Csongor, A. (2021). Breast cancer on social media: A quali-quantitative study on the credibility and content type of the most shared news stories. *BMC Women's Health*, *21*(1), 202. https://doi.org/10.1186/s12905-021-01352-y

*Additional articles*

**Biancovilli, P.**, de Oliveira, E. M., Thomer, L., & Jurberg, C. (2022). Social support and positivity: Analyzing user-generated comments on the Instagram pages of two Brazilian cancer hospitals. *Journal of Media and Communication Studies*, 14(2), 44-52. https://doi.org/10.5897/JMCS2022.0769

**Biancovilli, P**., Makszin, L., & Jurberg, C. (2021). Misinformation on social networks during the novel coronavirus pandemic: A quali-quantitative case study of Brazil. *BMC Public Health*, *21*(1), 1200. https://doi.org/10.1186/s12889-021-11165-1

**Biancovilli, P**., & Jurberg, C. (2020). *When governments spread lies, the fight is against two viruses: A study on the novel coronavirus pandemic in Brazil* [Preprint]. Public and Global Health. https://doi.org/10.1101/2020.10.20.20215962

**Biancovilli, P**., & Jurberg, C. (2018). How to Optimize Health Messages About Cancer on Facebook: Mixed-Methods Study. *JMIR Cancer*, *4*(2), e11073. https://doi.org/10.2196/11073

**Conference presentations**

**Biancovilli, P.,** Csongor, A. (2021, November). Hungarian doctors, health professionals and cancer researchers' attitudes towards online health communication on breast cancer. Poster presentation at the Magyar Onkológusok Társasága (MOT) XXXIV. Kongresszusa, Szeged, Hungary.

**Biancovilli, P.,** Csongor, A. (2020, October). Breast cancer and social networks: analysis of the credibility of the most shared content on Facebook and Twitter. Oral presentation at XXIII. Tavaszi Szél Konferencia 2020, Budapest, Hungary.

**Biancovilli, P.**; Csongor, A. (2019, November). Breast cancer cure and fake news: an analysis of content shared on social network sites. Poster session presented at MEDPécs (Medical Conference for PhD Students and Experts of Clinical Sciences), Pécs, Hungary.

**Biancovilli, P.** Csongor, A. (2019, September). Spreading reliable information on social networks: how can health educators counteract fake news about breast cancer. Oral presentation at Argumenting Health Communication in the Digital Era #healthsci19, Brescia, Italy.

**Biancovilli, P.**; Jurberg, C. (2019, May). How to optimize health messages about cancer on Facebook. Poster session presented at 8th Interdisciplinary Doctoral Conference (IDK 2019), Pécs, Hungary.